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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/670,487	09/25/2003	Ji Ung Lee	132614-1	8005

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GLOBAL RESEARCH
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EXAMINER	
ROY, SIKHA	

ART UNIT	PAPER NUMBER
2879	

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Please find below and/or attached an Office communication concerning this application or proceeding.

AK

Office Action Summary	Application No.	Applicant(s)	
	10/670,487	LEE ET AL.	
	Examiner	Art Unit	
	Sikha Roy	2879	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on 25 September 2003.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) 1-99 is/are pending in the application.

4a) Of the above claim(s) 1-68 is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) 69-99 is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☒ Claim(s) 1-68 are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☒ The drawing(s) filed on 25 September 2003 is/are: a)☒ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☒ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) Paper No(s)/Mail Date 9/25/03.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____.
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: _____.

DETAILED ACTION

Election/Restrictions

Restriction to one of the following inventions is required under 35 U.S.C. 121:

I. Claims 1-68, drawn to method of fabricating a field emission device, classified in class 445, subclass 24.

II. Claims 69-99, drawn to self-aligned gated field emission device, classified in class 313, subclass 495.

The inventions are distinct, each from the other because of the following reasons:

Inventions Group I and Group II are related as process of making and product made. The inventions are distinct if either or both of the following can be shown: (1) that the process as claimed can be used to make other and materially different product or (2) that the product as claimed can be made by another and materially different process (MPEP § 806.05(f)). In the instant case the product as claimed can be made by another materially different process such as the porous layer on the substrate can be made by selective etching using an etching template.

Because these inventions are distinct for the reasons given above and have acquired a separate status in the art as shown by their different classification, and because of their recognized divergent subject matter, restriction for examination purposes as indicated is proper.

During a telephone conversation with Mr. Paul Diconza on July 27, 2005 a provisional election was made with traverse to prosecute the invention of Group II,

claims 69-99. Affirmation of this election must be made by applicant in replying to this Office action. Claims 1-68 withdrawn from further consideration by the examiner, 37 CFR 1.142(b), as being drawn to a non-elected invention.

Applicant is reminded that upon the cancellation of claims to a non-elected invention, the inventorship must be amended in compliance with 37 CFR 1.48(b) if one or more of the currently named inventors is no longer an inventor of at least one claim remaining in the application. Any amendment of inventorship must be accompanied by a request under 37 CFR 1.48(b) and by the fee required under 37 CFR 1.17(i).

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

Claims 69-78, 84, 85, 87 -89, 91-94 and 99 are rejected under 35 U.S.C. 103(a) as being unpatentable over U.S. Patent 6,911,767 to Takai, and further in view of U.S. Patent 6,278,231 to Iwasaki et al.

Regarding claim 69 Takai discloses (Figs. 1, 3, column 9 lines 38-67, column 10 line 60 through column 11 line 5) a substrate 3010 having a surface and a predetermined thickness, a porous layer 3020 disposed adjacent to the surface, a plurality of substantially rod shaped structures 3040, wherein the rod-shaped structures protrudes above the surface of the porous layer, a gate dielectric layer 1040 (Fig.1)

having a surface and a predetermined thickness disposed on the surface of the porous layer wherein the gate dielectric layer is disposed between the plurality of substantially rod-shaped structures, a conductive layer 1050 (second metal film) having a predetermined thickness selectively disposed on the surface of the gate dielectric layer wherein the conductive layer is selectively disposed between the plurality of substantially rod-shaped structures.

Claim 69 differs from Takai in that Takai does not exemplify the porous layer defining a plurality of substantially cylindrical channels, each of the plurality of substantially cylindrical channels aligned parallel to one another and substantially perpendicular to the surface of the substrate and the plurality of rod-shaped structures disposed within at least a portion of the substantially cylindrical channels defined by the porous layer.

Iwasaki in analogous art of nanostructure electron emitting device discloses (Figs.1, 2 and 18, column 7 lines 1-17, column 19 line 36-39) nanostructures comprising a semiconductor substrate 11, a porous layer (anodized film) 13 defining plurality of substantially cylindrical channels 14 (nanoholes), aligned parallel to one another and substantially perpendicular to the surface of the substrate and plurality of rod-shaped structures (nanotubes) 202 disposed within the plurality of substantially cylindrical channels, the rods protruding above the surface of the porous layer 13. Iwasaki further teaches (column 3 lines 46-65) this configuration of nanostructures can be produced in a highly reliable fashion and provides completely cut-through nanoholes with uniform

depths (good uniformity and linearity of shape) and thus provides high performance electron emitting device capable of emitting large amount of electrons.

Therefore it would have been obvious to one of ordinary skill in the art at the time of invention to modify the porous layer with substantially cylindrical rod shaped structures of Takai to a porous layer defining plurality of substantially cylindrical channels, each of the plurality of substantially cylindrical channels aligned parallel to one another and substantially perpendicular to the surface of the substrate and the plurality of rod-shaped structures disposed within the substantially cylindrical channels defined by the porous layer as taught by Iwasaki for providing a high performance electron emitting device with uniform shaped nanostructures which can be produced in a highly reliable fashion.

Referring to claim 70 Takai discloses (column 9 lines 47-50) the substrate comprises a material selected from the group consisting of semiconductor (silicon) and metals.

Regarding claim 71 Takai discloses the substrate made of silicon.

Regarding claim 72 Takai discloses (column 5 line 48) the substrate made of aluminum.

Regarding claim 73, Takai and Iwasaki disclose the claimed invention except for the limitation of thickness of the substrate being between 1 micron and 550 micron. It has been held that where the general conditions of a claim are disclosed in the prior art, discovering the optimum or workable ranges involves only routine skill in the art. *In re Aller*, 105 USPQ 233. It is noted that the thickness of the substrate is selected so that it

supports the anodized porous layer along with the substantially rod-shaped structures. It would have been obvious to one having ordinary skill in the art at the time the invention was made to select the thickness of the substrate between 1 micron and 550 micron so that it can support the porous layer with the aligned rod-shaped structures, since optimization of workable ranges is considered within the skill of the art.

Regarding claims 74 and 75 Iwasaki discloses (column 7 lines 1-10) the porous layer comprising anodized aluminum oxide. The reason for combining art is same as of claim 69.

Regarding claim 76 Iwasaki discloses (column 19 lines 57-60) the thickness of the porous layer is 1μm which lies within the claimed range (0.5 to 5 micron) of thickness.

Regarding claim 77 Iwasaki discloses (column 17 lines 28,29) the diameter of the plurality of substantially cylindrical channels (nano holes) is about 50 nm.

Regarding claim 78 Iwasaki discloses (column 9 lines 51-61) the length (depth) of the plurality of substantially cylindrical channels is in the range of .01micron (10nm) to 100 micron.

Regarding claims 84 and 85 Takai discloses (column 10 lines 33-40) the rod-shaped structures (nanotubes) having diameter between 1.3nm to 200nm and length (average height) between 0.1micron to about 100 micron.

Regarding claim 87 Takai discloses (Fig. 1 column 9 lines 55-57) the thickness of the gate dielectric layer 1040 is about 1 micron.

Takai and Iwasaki disclose the claimed invention except for the limitation of thickness of the dielectric layer being between 1 nm and 25nm. It has been held that where the general conditions of a claim are disclosed in the prior art, discovering the optimum or workable ranges involves only routine skill in the art. *In re Aller*, 105 USPQ 233. It would have been obvious to one having ordinary skill in the art at the time the invention was made to select the thickness of the dielectric between 1nm and 25 nm so that the distance between the emitters and the gate is small and hence working voltage is reduced, since optimization of workable ranges is considered within the skill of the art.

Regarding claims 88 and 89 Takai discloses (column 9 lines 58-62) the conductive layer (second metal film) comprises metal selected from titanium, chrome.

Regarding claim 91 Takai discloses (column 9 lines 61,62) the thickness of the conductive layer (second metal film) is 200nm (0.2 micron).

Takai and Iwasaki disclose the claimed invention except for the limitation of thickness of the gate conductive layer being between 20nm and 100 nm. It has been held that where the general conditions of a claim are disclosed in the prior art, discovering the optimum or workable ranges involves only routine skill in the art. *In re Aller*, 105 USPQ 233. It would have been obvious to one having ordinary skill in the art at the time the invention was made to select the thickness of the grid between 20nm

and 100 nm so that it is close proximity of the aligned rod-shaped structures, and thus provides high emission current since optimization of workable ranges is considered within the skill of the art.

Regarding claim 92 Takai discloses (column 10 lines 1-4) the distance between the plurality of rod-shaped structures (same as the distance between the fine holes through which plurality of nanotubes protrude) is 2000nm (2 micron).

Takai and Iwasaki disclose the claimed invention except for the limitation of the rod shaped structures being separated by a distance of about 50nm and 500nm. It has been held that where the general conditions of a claim are disclosed in the prior art, discovering the optimum or workable ranges involves only routine skill in the art. *In re Aller*, 105 USPQ 233. It is to be noted that the number of plurality of rod-shaped emitters and hence emission current increases as the distance between them is reduced. It would have been obvious to one having ordinary skill in the art at the time the invention was made to select the distance between 50nm and 500 nm so that there is increased number of plurality of emitters and hence increased emission current since optimization of workable ranges is considered within the skill of the art.

Regarding claim 93 Takai discloses (column 1 lines 20-50, column 9 lines 27-31) the gated field emission device with reduced working voltage and increased longevity of emitter tips is used in a flat panel field emission display device.

Regarding claims 94 and 99 Takai and Iwasaki disclose all the limitations same as of claim 69 and additionally Takai discloses (column 1 lines 20-25, column 9 lines 27-31) the gated field emission device is used in a flat panel field emission display device, an electronic system.

Claims 79-83, 86 and 90 are rejected under 35 U.S.C. 103(a) as being unpatentable over U.S. Patent 6,911,767 to Takai, and U.S. Patent 6,278,231 to Iwasaki et al. and further in view of U.S. Patent 6,504,292 to Choi et al.

Regarding claim 79 Takai and Iwasaki do not explicitly disclose the substantially rod-shaped structures comprising metal.

Choi in same field of endeavor discloses (column 4 lines 52-67) the nanostructures comprising high melting point metals such as Mo, W, Ta. Choi further discloses the use of these metals is advantageous because minimize the undesirable diffusion of metal atoms to the emitting tip, providing continuous electron emission.

Therefore it would have been obvious to one of ordinary skill in the art at the time of invention to substitute carbon nanotubes of Takai and Iwasaki by nanostructures comprising metals such as Mo, W, Ta as taught by Choi for minimizing the undesirable diffusion of metal atoms to the emitting tip while providing continuous electron emission.

Regarding claim 80 Choi discloses rod-shaped structures comprising Mo, W, Ta.

Regarding claim 81 Takai and Iwasaki do not explicitly disclose the nanostructures comprising dielectric material.

Choi discloses (column 6 lines 61 through column 7 line 2) nanostructures comprising dielectric material which provides high-aspect ratio nanostructures and hence can be used as efficient field emitters.

Therefore it would have been obvious to one of ordinary skill in the art at the time of invention to include substantially rod-shaped structures of Takai and Iwasaki comprising dielectric material as suggested by Choi which provides high-aspect ratio nanostructures resulting in efficient field emitters.

Regarding claim 82 and 83 Choi discloses the rod-shaped structures comprising dielectric material of various oxides such as TiO_2, Al_2O_3.

Claim 86 differs from Takai and Iwasaki in that Takai and Iwasaki do not exemplify the gate dielectric layer comprising a material selected from SiO_2, Al_2O_3.

Choi discloses (column 7 lines 28) the gate dielectric layer comprising aluminum oxide (Al_2O_3) or silicon dioxide (SiO_2). It is noted that these materials are known in the art for being used as dielectric.

The selection of known materials for a known purpose is generally considered to be within the skill of the art. *In re Leshin*, 125 USPQ 416. It would have been obvious to use gate dielectric layer of Takai and Iwasaki comprising aluminum oxide (Al_2O_3) or silicon dioxide (SiO_2) as taught by Choi for providing electrical insulation between the emitter and conducting gate electrodes because the selection of known materials for a known purpose is within the skill of the art.

Regarding claim 90 Choi discloses (column 7 lines 46-48) the grid conductors comprising semiconductor material such as conductive ceramic material such as carbides (SiC).

Claims 95-98 are rejected under 35 U.S.C. 103(a) as being unpatentable over U.S. Patent 6,911,767 to Takai, and U.S. Patent 6,278,231 to Iwasaki et al. and further in view of Applicant's admitted prior art (AAPA).

Regarding claims 95, 96 Takai and Iwasaki are silent about the electronic system having self-aligned gated field emission device being an imaging and x-ray imaging system.

AAPA discloses (Background of the Invention section [0003]) use of electron emission device as an electron source in x-ray imaging devices to improve scan speeds.

Therefore it would have been obvious to one of ordinary skill in the art at the time of invention to use the self-aligned gated field emission device with increased emission current of Takai and Iwasaki as an electron source in x-ray imaging system as disclosed by AAPA for improving scan speed.

Regarding claims 97 and 98 Takai and Iwasaki do not disclose explicitly the electronic system self-aligned gated field emission device being a fluorescent lighting system.

AAPA discloses (Background of the Invention section [0003]) use of electron emission device as an electron source in a gas discharge lighting and fluorescent lighting system for providing longer life.

Therefore it would have been obvious to one of ordinary skill in the art at the time of invention to use the self-aligned gated field emission device with increased longevity of emitter tips of Takai and Iwasaki as an electron source in a fluorescent lighting as disclosed by AAPA for providing longer life of the lighting device.

Conclusion

The prior art made of record and not relied upon is considered pertinent to applicant's disclosure. U.S. Patent 5,726,524 to Debe and U.S. Patent 6,864,162 to Jin disclose field emission devices using gated field emission structures with nanowires. U.S. Patent 6,709,929 to Zhang et al. and U.S. Patent Application Publication 2003/0143398 to Ohki et al. disclose method of producing nano-scale electronic devices.

Contact Information

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Sikha Roy whose telephone number is (571) 272-2463. The examiner can normally be reached on Monday-Friday 8:00 a.m. – 4:30 p.m.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Nimeshkumar D. Patel can be reached on (571) 272-2457. The fax phone number for the organization is (703) 308-7382.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is (703) 308-0956.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

Sikha Roy

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